DWR OROVILLE FACILITIES RELICENSING PROJECT
(FERC Project No. 2100)

STUDY #1A: STATEWIDE OPERATIONS MODEL DEVELOPMENT

December 12, 2001

1.0 INTRODUCTION/BACKGROUND

Oroville Reservoir is operated by DWR as part of the State Water Project (SWP) for multiple purposes including:

- SWP water supply
- Flood Control
- Recreation
- Fisheries
- Delta Water Quality

Oroville Reservoir Operations in the Delta are also coordinated with USBR Central Valley Project Operations through the Coordinated Operating Agreement. Because of this Oroville Reservoir operations are driven by statewide parameters and changes to Oroville operations may have statewide impacts. In order to simulate Oroville operations and evaluate the impacts of changes to Oroville operations statewide modeling is required. This modeling will serve three distinct purposes:

- Define local water supply operation boundaries for detailed local impact operation modeling.
- Serve as base for analysis of any proposed project measures
- Allow verification that re-licensing measures do not have a statewide impact.

Statewide modeling is typically done for impact analysis purposes where simulations with and without project are performed and the difference used for the impact analysis. In that case the assumption can be made that if the model is not correct the same error exists in both simulations and the differences are still accurate. For this project the statewide modeling will be used to define boundary conditions for detailed analysis of Oroville – Thermalito Operations and impacts. This means that the absolute values from the simulations are extremely important. It also means that these simulations will form a critical base for all following analysis.

2.0 STUDY GOAL(S) AND OBJECTIVE(S)

The goal of this study is to develop appropriate statewide modeling tools and perform the benchmark simulations to allow determination of "boundary" conditions for localized modeling and to allow evaluation of statewide impacts of modified Oroville operations.

3.0 RELATIONSHIP OF THE STUDY PLAN TO RELICENSING PROJECT PROCESS/PURPOSE AND NEED FOR THE STUDY

Relationship of the Study Plan to Relicensing Project Process.

The relicensing process requires analysis of potential impacts from a wide range of operational alternatives. The model developed as a result of this study will be used to produce simulated operational data from these alternatives for use in the required analysis.

Purpose and Need for the Study

This study will develop the required tools and baseline studies that will allow analysis of impacts. The initial baseline studies are used to define the pre-project conditions. Additional simulations of alternatives using the statewide operations model can then be used to identify changes in operations and their impacts on other resource areas.

4.0 SCOPE – STUDY AREA

The study area includes the major facilites of the USBR Central Valley Project (CVP) and the DWR State Water Project (SWP). These include the Trinity, Sacramento, and San Joaquin river basins as well as the Sacramento – San Joaquin Delta and the Delta Mendota Canal (CVP) and California Aqueduct canal systems. (Include map when found)

5.0 GENERAL APPROACH

A generalized model of the SWP/CVP system, CALSIM II, jointly development by USBR and DWR, has recently been released by DWR for evaluation and comments from interested entities. CALSIM II is an enhanced version of the CALSIM model that will replace PROSIM, DWRSIM, and CALSIM as the only approved statewide modeling tool available for both agencies. The model features many updates to the basic hydrology, the surface water- ground water interface, enhancements to joint CVP-SWP operations, and revised b(2) and EWA implementations.

CALSIM II is the preferred tool for the long-term, statewide operations modeling for this project if it is completed and accepted by DWR, USBR, FERC and other parties and agencies involved in this re-licensing. Once the CALSIM II model is accepted there is a high probability that its use would be required in all analysis including this re-licensing. The schematic for the CALSIM II model is included as Attachment A.

There is an organized effort currently underway to systematically evaluate, and if required, enhance the released version of the CALSIM II model to be suitable for use in a number of ongoing investigations. The first step in this process will be the release of current and future level "benchmark" studies that are planned for use by a number of ongoing processes such as the USBR OCAP, Coordinated Operation Agreement negotiations, etc. The initial 2001 benchmark study is due for release Nov 7, 2001 with the initial 2020 benchmark study anticipated for release two to three weeks later.

The statewide modeling for this process will use the CALSIM II model and the 2001 and 2020 initial benchmark studies as the starting point for all statewide modeling activity.

Detailed Methodology and Analysis Procedures

Task 1 – Obtain CALSIM II model and initial 2001 and 2020 benchmark simulations

The CALSIM II model and the initial 2001 and 2020 benchmark studies will be available for download from DWR's web site when they are completed. Running CALSIM II requires purchase and installation of a linear programming solver, XA, and the Lahey FORTRAN 90 compiler. This task will include obtaining all the required software, installing the software and model, and rerunning the initial benchmark simulations to verify that the model is installed and working correctly.

Task 2 –Develop modified assumptions, if required, for benchmark studies for this process

The assumptions being used in the initial 2001 and 2020 benchmark simulations were developed for use in specific programs such as CALFED. Because this process is different from these programs the assumptions need to be reviewed and possibly modified to ensure that they are appropriate for use in the process. The draft initial assumptions for the 2001 and 2020 benchmark studies are included as Attachment B.

Task 3 – Perform benchmark simulations for this process

Perform the appropriate benchmark simulations for this process using the assumptions from Task 2. If the initial assumptions are not modified then this task will not be required. Task 1 will have already produced the appropriate simulations.

6.0 RESULTS AND PRODUCTS/DELIVERABLES

Results

This study plan will result in a statewide operations simulation model and 2001 and 2020 benchmark studies for use in the process.

Products/Deliverables

There will be two products of this study plan:

1. A statewide operation model of the CVP/SWP systems that is accepted as the standard model for this type of simulation by both DWR and USBR. This product will be fully integrated into the overall modeling scheme.
2. Simulated statewide operations for the 2001 and 2020 benchmark studies for use in other analysis.

7.0 STUDY PLAN COORDINATION AND IMPLEMENTATION STRATEGY

Coordination with Other Resource Areas/Studies

Engineering and Operation Study Plans

Study Plan No. 1 - Model Development
Study Plan No. 1a - Statewide Operations Model Development
Study Plan No. 1b - Local Operations Model Development
Study Plan No. 2 - Modeling Simulation

The identification of the appropriate assumptions for benchmark studies will need to be done in coordination with other workgroups and regulatory agencies. The assumptions selected will require approval at the plenary level.

Study Plan Tracking/Regulatory Compliance Requirements

None

8.0 REFERENCES

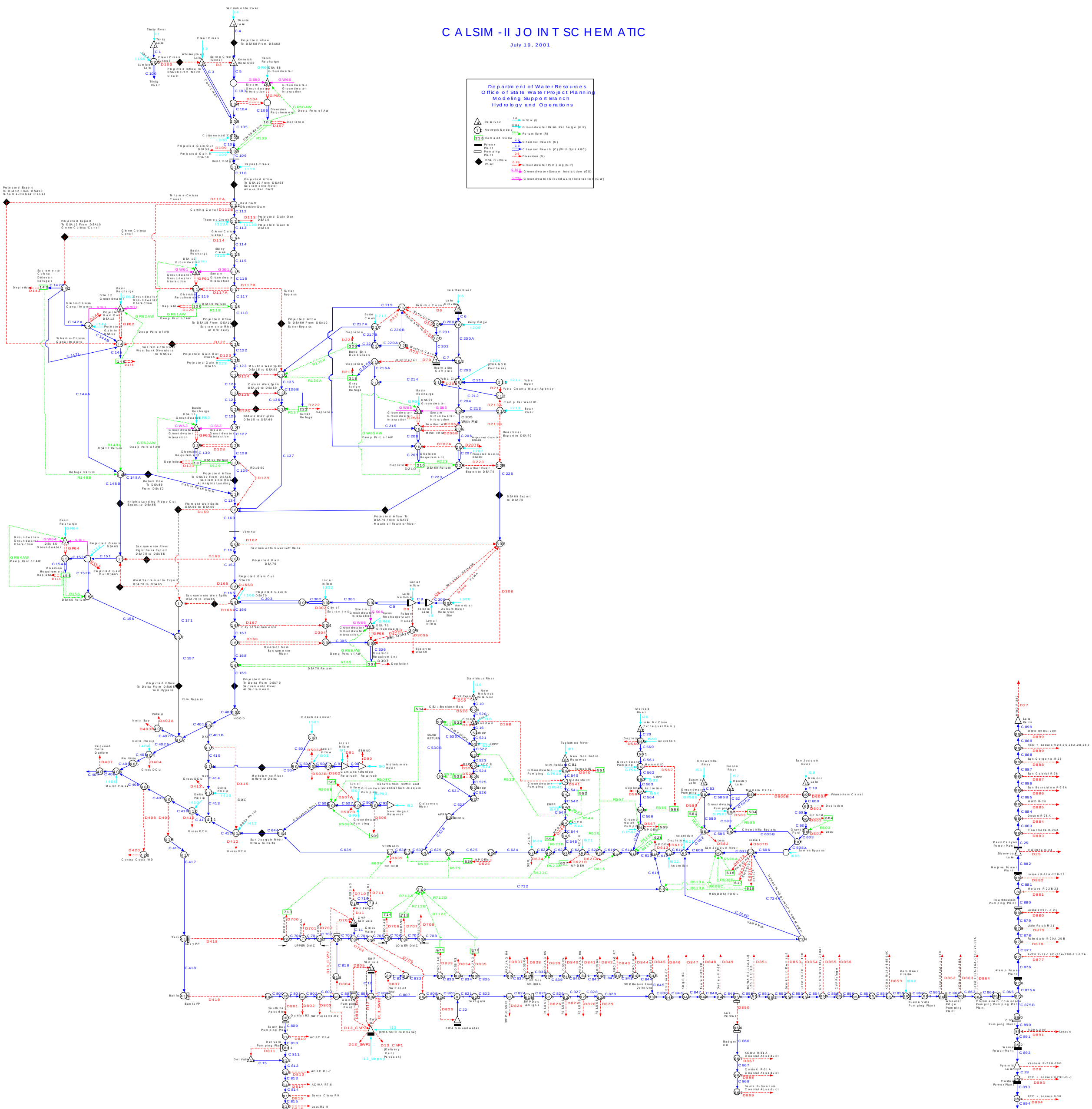
CALSIM II Work Plan, Water Management/Allocation Studies, CALFED/DWR/USBR, September 1, 2001.

Draft Benchmark Studies Assumptions, Water Management/Allocation Studies, CALFED/DWR/USBR, September 4, 2001.

ATTACHMENTS

A. CALSIM II Schematic
B. Draft Benchmark Studies Assumptions

Attachment A


CALSIM-II JOINT SCHEMATIC
July 19, 2001
Department of Water Resources
Office of State Water Project Planning
Modeling Support Branch
Hydrology and Operations
Reservoir
Network Nodes
Demand Node
Power Plant
Pumping Plant
DSA Outflow Point
Inflow (I)
Groundwater Basin Recharge (GR)
Return flow (R)
Channel Reach (C)
Channel Reach (C) (With Split ARC)
Diversion (D)
Groundwater Pumping (GP)
Groundwater-Stream Interaction (GS)
Groundwater-Groundwater Interaction (GW)

Attachment B

CALFED/DWR/USBR

Water Management/Allocation Studies

Draft Benchmark Studies Assumptions

September 4, 2001

INTRODUCTION

This Draft Benchmark Studies Assumptions document has been developed in support of the CALFED/DWR/USBR Water Management/Allocation Studies CALSIM II Work Plan. The purpose of this document is to present a concise summary of the assumptions associated with the CALFED/DWR/USBR Water Management/Allocation Studies Existing Conditions and Future 2020 No-Action Alternative benchmark simulations. By defining and documenting a set of common assumptions, this document serves as a foundation for the development, quality control, and subsequent analysis of all the model simulations.

This document presents the benchmark assumptions at four levels of detail in an attempt to meet the needs of managers, technical staff, and model users. The first section, Summary of Major Assumptions, is intended for managers and provides a brief overview matrix (Table 1) of the items included in the Existing Condition and Future 2020 No-Action Alternative. The second section, CALSIM II Model Overview, provides general description of the CALSIM II model. The third section, Benchmark Studies Assumptions, is intended for technical staff and provides additional information on each of the major assumptions identified in Table 1 of the summary section. Finally, there are eight appendices which contain more detailed descriptions of the technical aspects of the major assumptions and their implementation in the CALSIM II model.

The model to be applied in developing these simulations is the joint DWR/USBR operations planning model, CALSIM II. Other models will be used in conjunction with the CALSIM II model to complete the alternatives evaluation process. Key assumptions and issues are presented in this document pertaining to the extended use of CALSIM II results with other models as appropriate.

SUMMARY OF MAJOR ASSUMPTIONS

The benchmark simulations for the Water Management/Allocation Studies include an Existing Condition and Future 2020 No-Action Alternative. These simulations will serve as the basis for evaluating the benefits and impacts of a wide variety of proposed facility, regulatory and operational alternatives identified in the CALFED ROD. A listing of the major assumptions associated with these benchmark studies is provided in Table 1. The information in Table 1 is organized into the following four categories:

- Hydrology
- Facilities
- Regulatory Standards
- Operations Criteria

CALSIM II MODEL OVERVIEW

CALSIM II is the replacement for the PROSIM/SANJASM (USBR) and DWRSIM (DWR) models. CALSIM II includes a variety of model enhancements to better characterize and simulate the operations of the CVP and SWP systems. These enhancements are briefly described below. Eight supporting appendices present more detailed information about the assumptions and methods used in developing the benchmark simulations. Refer to the appropriate appendix for further information.

CALSIM II is a general-purpose planning simulation model developed by DWR and USBR for simulating the operation of California's water resources system, specifically the CVP and SWP. On a monthly time-step, CALSIM II utilizes optimization techniques to route water through a network. A linear programming (LP)/mixed integer linear programming (MILP) solver determines an optimal set of decisions for each time period given a set of weights and system constraints. A key component for specification of the physical and operational constraints is the WRESL language. The model user describes the physical system (dams, reservoirs, channels, pumping plants, etc.), operational rules (flood-control diagrams, minimum flows, delivery requirements, etc.), and priorities for allocating water to different uses in WRESL statements. Refer to Appendix A, CALSIM II General Modeling Approach, for more information.

CALSIM II should not be used to prescribe seasonal or guide "real-time" operations, predict flows or water deliveries, or serve as the basis for predicting values of parameters dependent on hydrologic information. CALSIM II should only be used in a comparative mode, for planning level evaluations of proposed actions as compared to defined No-Action Alternative

Geographic Coverage

The valley floor drainage area of the Sacramento and San Joaquin Rivers, the upper Trinity River, and the San Joaquin Valley, Tulare Basin, and southern California areas served by the Federal Central Valley Project (CVP) and the California State Water Project (SWP) are simulated in CALSIM II. The focus of CALSIM II is on the major CVP and SWP facilities, but operations of many other facilities are included to varying degrees. Refer to Appendix A for more information.

Hydrology

CALSIM II includes a new hydrology developed jointly by DWR and USBR. Water diversion requirements (demands), stream accretions and depletions, rim basin inflows, irrigation efficiency, return flows, non-recoverable losses, and groundwater operation are components that make up the hydrology used in CALSIM II. Sacramento Valley and tributary rim basin hydrologies are developed using a process designed to adjust the historical sequence of monthly stream flows to represent a sequence of flows at a future level of development. Adjustments to historic water supplies are determined by imposing future level land use on historical meteorological and hydrologic conditions.   San Joaquin River basin hydrology is developed using fixed annual demands and regression analysis to develop accretions and depletions. The resulting hydrology represents the water supply available from Central Valley streams to the CVP and SWP at a future level of development. Refer to Appendix B, DWR/USBR Joint Hydrology, for more information.

Delta Water Quality

CALSIM II uses an Artificial Neural Network (ANN) to simulate the flow-salinity relationships for the Delta. This ANN flow-salinity model correlates DSM2 model-generated salinity at key locations in the Delta with Delta inflows, Delta exports, and Delta Cross Channel operations. The ANN flow-salinity model estimates electrical conductivity at the following four locations for the purpose of modeling Delta water quality standards: Old River at Rock Slough, San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville. In its estimates, the model considers antecedent conditions up to 148 days. Refer to Appendix D for more information.

CVP/SWP Delivery Logic

CALSIM II uses new logic for determining deliveries to north-of-Delta and south-of-Delta CVP and south-of-Delta SWP contractors. The delivery logic uses runoff forecast information which incorporates uncertainty and standardized rule curves (i.e. Water Supply Index versus Demand Index Curve) to estimate the water available for delivery and carryover storage. Updates of delivery levels occur monthly from January 1 through May 1 for the SWP and March 1 through May 1 for the CVP as water supply parameters become more certain. The south-of Delta SWP delivery is determined based upon water supply parameters and operational constraints. The CVP system wide delivery and south-of-Delta delivery are determined similarly upon water supply parameters and operational constraints with specific consideration for export constraints. Refer to Appendix E, CVP/SWP Delivery Allocation and Operations Rules, for more information.

CVPIA 3406(b)(2) Water

CALSIM II incorporates new procedures for dynamic modeling of CVPIA 3406(b)(2) water and the Environmental Water Account (EWA), under the CALFED Framework and Record of Decision (ROD). Per the October 5, 1999 Decision, CVPIA 3406(b)(2) accounting procedures are based on system conditions under operations associated with SWRCB D-1485 and D-1641 regulatory requirements. Similarly, the operating guidelines for selection of actions and allocation of assets under the EWA are based on system conditions under operations associated with SWRCB D-1641 regulatory requirements. This requires sequential layering of multiple system requirements and simulations.

CVPIA 3406(b)(2) allocates 800 TAF (600 TAF in Shasta critical years) of CVP project water to targeted fish actions. Up to 450 TAF, of this amount, provides support for SWRCB D-1641 implementation. According to monthly accounting, 3406(b)(2) actions are dynamically selected according to an action matrix. Several actions in this matrix have defined reserve amounts that limit 3406(b)(2) expenditures for lower priority actions early in the year such that the higher priority actions can be met later in the year. Refer to Appendix G for more information.

Environmental Water Account

Under CALFED, the EWA acquires water through "operational" and "fixed" assets, and then allocates water to targeted fish actions. "Operational" assets include relaxation of regulatory requirements and dedication of conveyance capacities to EWA purposes. "Fixed" assets are water purchased from willing sellers or previously banked supplies. According to monthly accounting, EWA assets are evaluated and actions are dynamically selected according to an action matrix. Several actions in this matrix have defined reserve amounts that limit EWA allocation for lower priority actions early in the year such that the higher priority actions can be met later in the year, subject to uncertain "operational" assets. Refer to Appendix H, EWA Operations /Accounting, for more information.

Table 1: CALSIM II Benchmark Studies Assumptions

	Existing Condition	Future No-Action Alternative
Period of Simulation	73 years (1922-1994)	Same
HYDROLOGY		
Level of Development (Land Use)	2001 Level, DWR Bulletin 160-98[1]	2020 Level, DWR Bulletin 160-98
Demands		
North of Delta (exc American R)		
CVP	Land Use based, limited by Full Contract	Same
SWP (FRSA)	Land Use based, limited by Full Contract	Same
Non-Project	Land Use based	Same
CVP Refuges	Firm Level 2	Same
American River Basin		
Water rights	2001[2]	2020, Sacramento Water Forum[3]
CVP	2001[4]	2020, Sacramento Water Forum[5], and EBMUD[6]
San Joaquin River Basin		
Friant Unit	Regression of historical	Same
Lower Basin	Fixed annual demands (source unknown)	Same
Stanslaus River Basin	New Melones Interim Operations Plan	Same
South of Delta		
CVP	Full Contract	Same
CCWD	140 TAF/YR[7]	195 TAF/YR[8]
SWP (w/ North Bay Aqueduct)	2.7-3.8 MAF/YR	3.4-4.2 MAF/YR
SWP Interruptible Demand	No MWDSC, others up to 84 TAF/month	MWDSC up to 50 TAF/month, Dec-Mar, others up to 84 TAF/month
FACILITIES		
	Existing Facilities (2001)	Same
REGULATORY STANDARDS		
Trinity River		

[1] 2000 Level of Development defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from DWR Bulletin 160-98

[2] 1998 Level Demands defined in Sacramento Water Forum's EIR with a few updated entries; assumptions for each purveyor are presented in Appendix B

[3] Sacramento Water Forum 2025 Level Demands defined in Sacramento Water Forum's EIR; assumptions for each purveyor are presented in Appendix B

[4] Same as footnote 2

[5] Same as footnote 3

[6] Freeport Alternative defined in EBMUD Supplemental Water Supply Project REIR / SEIS; assumptions are presented in Appendix B

[7] Delta diversions include operations of Los Vaqueros Reservoir operations

[8] Same as footnote 7

	Existing Condition	Future No-Action Alternative
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/YR)	Same
Trinity Reservoir End-of-September Minimum Storage	Trinity EIS Preferred Alternative (600 TAF as able)	Same
<u>Clear Creek</u>		
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to USFWS and NPS, and USFWS discretionary use of CVPIA 3406(b)(2)	Same
<u>Upper Sacramento River</u>		
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1900 TAF)	Same
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and USFWS discretionary use of CVPIA 3406(b)(2)	Same
<u>Feather River</u>		
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement (600 CFS)	Same
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement (1000 – 1700 CFS)	Same
<u>American River</u>		
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and USFWS discretionary use of CVPIA 3406(b)(2)	Same
Minimum Flow at H Street Bridge	SWRCB D-893	Same
<u>Lower Sacramento River</u>		
Minimum Flow near Rio Vista	SWRCB D-1641	Same
<u>Mokelumne River</u>		
Minimum Flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100 – 325 CFS)	Same
Minimum Flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25 – 300 CFS)	Same
<u>Stanislaus River</u>		
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement , and USFWS discretionary use of CVPIA 3406(b)(2)	Same
Minimum Dissolved Oxygen	SWRCB D-1422	Same
<u>Merced River</u>		
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 CFS, Nov – Mar), and Cowell Agreement	Same
Minimum Flow at Shaffer Bridge	FERC 2179 (25 – 100 CFS)	Same
<u>Tuolumne River</u>		
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94 – 301 TAF/YR)	Same
<u>San Joaquin River</u>		
Maximum Salinity near Vernalis	SWRCB D-1641	Same
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement	Same
<u>Sacrameto River-San Joaquin River Delta</u>		
Delta Outflow Index (Flow and	SWRCB D-1641	Same

	Existing Condition	Future No-Action Alternative
Salinity)		
Delta Cross Channel Gate Operation	SWRCB D-1641	Same
Delta Exports	SWRCB D-1641, USFWS discretionary use of CVPIA 3406(b)(2), and CALFED Fisheries Agencies discretionary use of EWA	Same
OPERATIONS CRITERIA		
Subsystem		
Upper Sacramento River		
Flow Objective for Navigation (Wilkins Slough)	Discretionary 3,500 – 5,000 CFS based on Lake Shasta storage condition	Same
American River		
Folsom Dam Flood Control	SAFCA, Interim-Reoperation of Folsom Dam, Variable 400/670 (without outlet modifications)	Same
Flow below Nimbus Dam	Discretionary operations criteria corresponding to SWRCB D-893 required minimum flow	Same
Sacramento Water Forum Mitigation Water	None	Sacramento Water Forum (up to 47 TAF/YR in dry years)
Stanislaus River		
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	Same
San Joaquin River		
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program	Same
System-wide		
CVP Water Allocation		
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	Same
CVP Refuges	100% (75% in Shasta Critical years)	Same
CVP Agriculture	100% - 0% based on supply (reduced by 3406(b)(2) allocation)	Same
CVP Municipal & Industrial	100% - 50% based on supply (reduced by 3406(b)(2) allocation)	Same
SWP Water Allocation		
North of Delta (FRSA)	Contract specific	Same
South of Delta	Based on supply; Monterey Agreement	Same
CVP/SWP Coordinated Operations		
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement	Same
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	Same
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641; use of CVPIA 3406(b)(2) only restricts CVP exports; EWA use restricts CVP and/or SWP as directed by CALFED Fisheries Agencies	Same
CVPIA 3406(b)(2)		

	Existing Condition	Future No-Action Alternative
Allocation	800 TAF/YR (600 TAF/YR in Shasta Critical years)	Same
Actions	AFRP flow objectives (Oct-Jan), CVP export reduction (Dec-Jan), 1995 WQCP (up to 450 TAF/YR), VAMP (Apr 15- May 16) CVP export restriction, Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Pre (Apr 1-15) VAMP CVP export restriction, CVP export reduction (Feb-Mar), Additional Upstream Releases (Feb-Sep)	Same
CALFED Environmental Water Account		
Actions	Total exports restricted to 4000 CFS, 1 wk/mon, Dec-Mar (wet year: 2 wk/mon), VAMP (Apr 15- May 16) export restriction, Pre (Apr 1-15) and Post (May 16-31) VAMP export restriction, Ramping of export (Jun)	Same
Assets	50% of use of JPOD, 50% of any CVPIA 3406(b)(2) or ERP releases pumped by SWP, flexing of Delta Export/Inflow Ratio (not explicitly modeled), dedicated 500 CFS increase of Jul – Sep Banks PP capacity, north-of-Delta (35 TAF/Yr) and south-of-Delta purchases (50 – 200 TAF/Yr), 100 TAF/Yr from south-of-Delta source shifting agreements, and 200 TAF/YR south-of-Delta groundwater storage capacity	Same
Debt restrictions	No planned carryover of debt past Sep, no reset of unpaid debt, debt carried past Sep paid back by Feb	Same

BENCHMARK STUDIES ASSUMPTIONS

References to authoritative documents are used where available. CALSIM II specific interpretations of assumptions are provided when interpretation and variation from authoritative documents is not obvious. Presentations are referred to and are presented in the appendices that provide additional detail on the interpretation of assumptions and model application.

HYDROLOGY

Level of Development

Source: DWR Bulletin 160-98

CALSIM II uses a hydrology which is in part the result of an analysis of agricultural and urban land use. The assumptions used for land use result from aggregation of historical survey and projected data developed for the California Water Plan Update (Bulletin 160). The last Bulletin 160 was published in 1998. Land use data is used in the development of CALSIM II hydrology pertaining to the Sacramento Valley floor. More information is provided in Appendix B.

2001 Level Land Use:

Only historical 1995 and projected 2020 data was developed for Bulletin 160-98. The 2001 Level Land Use was defined through linear interpolation of the 1995 and 2020 data. Table 2 identifies the 2001 Level Land Use assumptions for the depletion study areas (DSA) that make up the Sacramento Valley floor.

2020 Level Land Use:

Projected 2020 Level data was developed for Bulletin 160-98. Table 2 identifies the 2020 Level Land Use assumptions for the depletion study areas (DSA) that make up the Sacramento Valley floor.

Table 2: Level of Development - Land Use Assumptions

DSA	2001		2020		Difference	
	Urban	Agriculture	Urban	Agriculture	Urban	Agriculture
58	77,624	36,512	110,000	33,700	32,376	-2,812
10	24,560	190,784	33,000	199,600	8,440	8,816
12	9,076	373,916	12,800	386,000	3,724	12,084
15	3,736	279,344	4,800	279,800	1,064	456
69	57,364	390,492	81,000	384,450	23,636	-6,042
65	43,620	262,988	61,000	255,600	17,380	-7,388
70	205,484	122,312	284,600	108,100	79,116	-14,212
54	19,469	296,778	24,440	293,860	4,971	-2,918
55	27,492	135,088	35,700	128,400	8,208	-6,688
Total	468,425	2,088,214	647,340	2,069,510	178,915	-18,704

Demands – North-of-Delta ***(excluding the American River Basin)***

Source: DWR/USBR Joint Hydrology

Demands in the Sacramento River Basin, including the Feather River, are determined based on land use for each depletion area. The land use acreage used to develop water demands is based on the desired Level of Development (LOD). A Consumptive Use model is used to estimate demands for each depletion study area (DSA).

Demands within each DSA must be disaggregated into CVP and/or SWP project and non-project demands. Project demands are subject to reduced water allocations based on contracts with the CVP and SWP, while non-project demands are satisfied from sources other than the CVP and SWP project facilities.

Non-project demands can be associated with senior riparian water rights, ground water pumping, or private storage projects. Releases from CVP and SWP are increased to satisfy project demands, but no additional releases are made to satisfy non-project demands.

Demands in the Sacramento Basin are divided into project/non-project in CALSIM II using a GIS "snapshot" of the crop and urban acreage (based on county surveys done in the 1990's). The CVP and SWP district boundaries were superimposed on Depletion Area boundaries, and the project area percentages are determined (Table 3).

Table 3: Project / Non-project Land Use Split

DSA	Project % by land area	Non-project % by land area
10	19	81
12	75	25
15	66	34
58	90	10
65	12	88
69	70	30
70	71	29

These percentages are then applied to the diversion requirement as calculated by the Consumptive Use model to determine the project and non-project demands in each depletion area.

CVP contracts in the Sacramento Valley, excluding the American River Basin, consist of Settlement contracts (approximately 2.2 MAF) and agricultural service contracts (approximately 460 TAF). Feather River Service Area (FRSA) demands are the only SWP demands north of the Delta. The FRSA users are entitled to approximately 1.0 MAF/Yr diversion from the Feather River. Although diversion requirements for contractors north of the Delta are determined using the consumptive use model based on land use, their deliveries are limited to the maximum under their contract amount by CALSIM II. More information is provided in Appendix B.

Demands – CVP Refuges – Firm Level 2

Source: USBR Report On Refuge Water Supply Investigations Central Valley Hydrologic Basin, California - March 1989 and USBR DRAFT Refuge Water Supply - Long Term Water Supply Agreements, San Joaquin River Basin - November 2000

Firm Level II, current average annual, national wildlife refuge water demands are used for the Sacramento, San Joaquin, and Tulare basins. The refuge demands are consistent with the USBR Report On Refuge Water Supply Investigations, Central Valley Hydrologic Basin, California - March 1989, with the exception of East Bear Creek Unit data that is from Table 1-1 of USBR DRAFT Refuge Water Supply - Long Term Water Supply Agreements, San Joaquin River Basin - November 2000. The quantities in the following Table 4 represent the amount of water that needs to be diverted in order to meet refuge demands at the refuge boundaries (firm). Thus, they include conveyance losses.

Table 4: Refuge Water Demand- Firm Level 2

Table 4-A: Sacramento Basin	Total (AF)
Sacramento NWR Complex	
Sacramento NWR	61,867
Delevan NWR	29,267
Colusa NWR	33,333
Sutter NWR	26,111
Gray Lodge WMA	40,602
Modoc NWR	23,752
Total	214,932

Table 4-B: Tulare Basin	Total (AF)
Pixley NWR	1,280
Kern NWR	11,437
Total	12,717

Table 4-C: San Joaquin Basin	Total (AF)
San Luis NWR Complex	
San Luis Unit	17,800
West Bear Creek Unit	9,609
Kesterson Unit	7,647
Freitas Unit	4,702
Merced Unit	13,500
East Bear Creek Unit	8,863
Los Banos WMA	13,253
Volta WA	13,000
North Grassland WMA	
China Island Unit	8,196
Salt Slough Unit	7,859
Mendota WMA	27,594
Grassland RCD	147,059
Total	279,082

Demands – American River Basin

Source: 1999 Sacramento Water Forum EIR/S

Surface water deliveries are subject to reductions during dryer years based on the Water Forum Agreement. Table 5 summarizes the surface water demands for the American River.

The Water Forum Agreement provides for surface diversion reductions from the American River in "dry" through "driest" years. "Driest" year diversions are no greater than the "1995 Baseline" defined by the Water Forum participants. A "Dry" year is defined as a year in which the forecasted Folsom Unimpaired Inflow (FUI) for Mar – Nov (modeled as Mar 1 – Sep 30 plus 60 TAF) is less than 950 TAF. A "Driest" year is defined as a year in which the forecasted Folsom Unimpaired Inflow (FUI) for Mar – Nov is less than 400 TAF. The assumptions for each purveyor used are described in detail in Appendix B. Also refer to Water Forum Mitigation Water/Operations Criteria section for more information on the Water Forum Agreement and how it is implemented.

Table 5: American River Demand Summary (TAF/Yr)

	CVP Agricultural Contracts	CVP M&I Contracts	Water Rights / Non-Project	Total	Total "Driest" Year	Approximate "Driest" Year Reduction
Total 2001 Level	0	65,850	231,350	297,200		0
Total 2020 Level	15,000	180,850	400,850	596,700	450,100	146,600

Demands – San Joaquin River Basin

Source: USBR's San Joaquin River Simulation Model (SANJASM)

Demands in the San Joaquin River Basin are generally set to fixed annual amounts rather than based on land use and hydrologic conditions as for the Sacramento Valley demands presented above. The operation of the Friant Unit is extracted from a SANJASM model simulation and is not operated in CALSIM II. The following Table presents annual average diversions and fixed annual demands for projects in the San Joaquin River Basin. For more information refer to Appendix B.

Table 6: San Joaquin River Basin Demand Assumptions

	Demand (TAF)	
Friant-Kern canal	1,100	*
Madera Canal to Madera ID	145	*
Madera Canal to Chowchilla ID	98	*
Madera ID	386	**
Chowchilla	293	**
Merced ID	620	**
Turlock ID	733	**
Modesto ID	417	**
Tri-dams	574	**
*Annual average delivery **Fixed Annual demand		

Demands – South-of-Delta

Source: CVP and SWP Contract data

CVP and SWP demands south of the Delta are based on contract amounts, SWP demands vary depending on a wetness index.

CVP South-of-Delta:

South-of-Delta CVP demands include agricultural and M&I needs served from the San Luis Reservoir and San Felipe Unit, the Cross Valley Canal, the Delta-Mendota Canal and Mendota Pool. CVP demands south of the Delta are always set to contract amount and do not vary based on hydrologic conditions. These demands also contain exchange contractors, refuge water supplies and operational losses. CVP demands are aggregated based on contract type and the following geographic locations: Upper DMC, Lower DMC, Mendota Pool, San Felipe Unit, and California Aqueduct.

Monthly demand patterns are determined for Exchange, M&I, and agricultural contractors based on recent historical CVP deliveries. Table 7 contains a summary of the total CVP demands south of the Delta, not including refuge demands. Refer to Appendix B for more information.

Table 7: CVP South-of-Delta Contract based Demands

Contract Type	Amount (AF)
Water Right	40,813
Project AG	1,824,758
Exchange	840,000
M&I	154,150
Losses	183,700
Total	3,043,421

SWP South-of-Delta:

Twenty-nine agencies have contracts for a long-term water supply from the SWP totaling about 4.2 million acre-feet annually, of which about 4.1 million acre-feet are for contracting agencies with service areas south of the Sacramento-San Joaquin Delta. About 70 percent of this amount are the contract entitlement for urban users and the remaining 30 percent for agricultural users.

Demands are set in accordance with the Monterey Agreement. They are calculated from the 1996 Table A entitlements. Aqueduct deliveries to San Joaquin Valley agricultural contractors are reduced in wetter years using a wetness index developed from annual Kern River inflows to Lake Isabella. Deliveries to Metropolitan Water District of Southern California (MWDSC) are reduced in wetter years using the 10-station, two-year average precipitation index or based upon

MWDSC integrated operations with Eastside Reservoir in future scenarios. Refer to Appendix B for more information.

SWP Interruptible:

When available, "interruptible" water is delivered to SWP south-of-Delta contractors in accordance with the Monterey Agreement. Interruptible water results from direct diversions from Banks Pumping Plant; it is not stored in San Luis Reservoir for later delivery to contractors. A contractor may accept interruptible water in addition to its monthly scheduled entitlement water. Interruptible water deliveries do not impact entitlement water allocations. If demand for interruptible water is greater than supply in any month, the supply is allocated in proportion to the Table A entitlements of those contractors requesting interruptible water. Refer to Appendix B for more information.

FACILITIES

Only existing facilities (in place in year 2001) have been included in these simulations.

Table 8 and Table 9 identify the major facilities included in CALSIM II. Specific criteria have been defined for each of these facilities for implementation into the model. Criteria include physical characteristics, evaporation and loss estimates, regulatory and operational requirements and integration of each facility into the system. Many of these requirements are described throughout this document. Refer to Appendix A for an overview of how these facilities fit into the system and how they are modeled in CALSIM II.

Table 8: Major Storage Facilities

	Gross Storage Capacity (TAF)
Sacramento Basin	
Clair Engle Lake	2447
Whiskeytown Lake	240
Shasta Lake	4552
Keswick Reservoir	24
Lake Oroville	3558
Thermalito Forebay	12
Folsom Lake	975
Lake Natoma	9
CVP / SWP South-of-Delta	
Cvp San Luis Reservoir	972
Swp San Luis Reservoir	1067
Lake Del Valle	77
Silverwood Lake	75
Lake Perris	131
Pyramid Lake	171
Castaic Lake	324
San Joaquin River Basin	
Millerton Lake	521

Hensley Lake	90
Eastman Lake	151
Lake Mcclure	1024
New Don Pedro Reservoir	2030
New Melones Reservoir	2420
Tulloch Lake	67
New Hogan Reservoir	325
Pardee Reservoir	210
Camanche Reservoir	438

Table 9: Major Conveyance Facilities

	Conveyance Capacity (CFS)
Clear Creek Tunnel	3300
Spring Creek Tunnel	4200
California Aqueduct upstream of O'Neill Forebay	10000
California Aqueduct downstream of O'Neill Forebay	13100
California Aqueduct downstream of end of joint use reach	8100
California Aqueduct upstream of Cross Valley Canal	5950
California Aqueduct downstream of Cross Valley Canal	5350
California Aqueduct downstream of Wheeler Ridge Pmp Plant	4600
California Aqueduct beginning of East Branch	3149
California Aqueduct beginning of West Branch	3129
San Luis Pumping Plant	11000
Delta Mendota Canal upstream of O'Neill Forebay	4200
Delta Mendota Canal downstream of O'Neill Forebay	3500
Delta Mendota Canal upstream of Delta Mendota Pool	3200

REGULATORY STANDARDS

Trinity River - Trinity EIS/R Preferred Alternative

Source: Trinity Mainstem Fishery Restoration – EIS/R – November 2000

Minimum Flow below Lewiston Dam:

Table 10 identifies 5 classes of water-years which are used to determine the annual volume of minimum flows below Lewiston Dam. Table 11 identifies the schedule of flows for each of these water-year classes.

Table 10: Trinity River Water-year Classification

	Trinity Reservoir Inflow (Oct-Sep, TAF)	Minimum Flow Volume (Oct-Sep, TAF)
Critically Dry (CD)	< 650	369
Dry (D)	650 – 1025	453
Normal (N)	1025 – 1350	636
Wet (W)	1350 – 2000	701
Extremely Wet (EW)	> 2000	815

Table 11: Trinity River Minimum Flow Schedules (CFS)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
CD	373	300	300	300	300	300	600	1498	783	450	450	450
D	373	300	300	300	300	300	540	2924	783	450	450	450
N	373	300	300	300	300	300	493	4189	2120	1102	450	450
W	373	300	300	300	300	300	460	4710	2526	1102	450	450
EW	373	300	300	300	300	300	427	4570	4626	1102	450	450

Trinity Reservoir End-of-September Minimum Storage:

The EIS/R suggests a minimum carryover objective of 600 TAF at Trinity Reservoir to help provide coldwater resource protection. This objective cannot be fully accomplished in extended drought periods.

Clear Creek – Downstream Water Rights and 1963 USBR Proposal to USFWS and National Park Service (NPS)

Source: CVP-OCAP 1992

This agreement was never formalized, but USBR operates Whiskeytown Dam to this schedule as a matter of convenience to comply with the 1960 DFG agreement and water rights settlement agreements on Clear Creek.

Minimum Flow below Whiskeytown Dam:

Table 12 identifies the proposed flow schedules under the 1963 USBR proposal. Critical years are identified under the Shasta Index critical year criteria. These flows apply to the entire length of Clear Creek, therefore additional flows are needed to insure the satisfaction of downstream water rights diversions. DWR developed the time series of additional flows through analysis of historical data. CALSIM II implements a combined water rights and 1963 USBR proposed flow schedule for minimum flow below Whiskeytown Dam.

Table 12: Clear Creek Proposed Flow Schedules (CFS)

	Normal Year	Critical year
Jan. 1 – Oct. 31	50	30
Nov. 1 – Dec. 31	100	70

Clear Creek - USFWS discretionary use of CVPIA 3406(b)(2) – Whiskeytown Release Objective

Source: 1997 CVPIA Administrative Proposal – Management of Section 3406(b)(2) Water

Minimum Flow below Whiskeytown Dam:

A procedure for implementing CVPIA Section 3406(b)(2) based AFRP actions and accounting is incorporated into CALSIM II. This procedure is documented in Appendix G. The procedure maintains a 3406(b)(2) water account and allocates the account based on forecast information and action specific priorities. Refer to the 3406(b)(2) section under Operations Criteria. Management agencies are continuing to refine the rules for implementation of 3406(b)(2), so until further information is available, the schedules shown in Table 13 are assumed for Whiskeytown releases. Stability criteria require November and December flow objectives to equal or exceed October's flows, and February through May flow objectives to equal or exceed January's flows.

Table 13: Clear Creek Flow Schedules

Month	Trinity Reservoir Previous Month Storage (MAF)	Whiskeytown Release (CFS)
October	> 1.40 > 0.75 < 0.75	200 150 100
November	> 1.40 > 0.70 < 0.70	200 150 100
December	> 1.40 > 0.80 < 0.80	200 150 100
January	> 1.15 > 0.85 < 0.85	200 150 100
February	> 1.30 > 0.90 < 0.90	200 150 100
March	> 1.45 > 1.00 < 1.00	200 150 100
April	> 1.60 > 1.20 < 1.20	200 150 100
May	> 1.60 > 1.20 < 1.20	200 150 100
June	> 1.10 < 1.10	150 100
July	> 1.00 < 1.00	150 100
August	> 0.90 < 0.90	150 100
September	> 0.90 < 0.90	150 100

Sacramento River – SWRCB WR 90-5 and 1993 Winter-run Biological Opinion

Source: 1993 NMFS Biological Opinion for the Operation of the Federal Central Valley Project and the California State Water Project.

Shasta Lake End-of-September Minimum Storage:

The 1993 Winter Run Biological Opinion includes provisions for minimum carryover storage in Lake Shasta. The Bureau must maintain a minimum end-of-September carryover storage in Shasta Reservoir of 1.9 MAF. A carryover storage of 1.9 MAF in Shasta Reservoir has been judged by the NMFS and DFG to be attainable in all but critical and extremely critical water year types (approximately 10% of years).

Flow below Keswick Dam:

The 1993 Winter Run Biological Opinion includes provisions for control of riverine temperatures downstream from Keswick Dam. In general, the 1993 Winter Run Biological Opinion requires daily average water temperatures no more than 56°F at Bend Bridge from April 15 through September , and 60°F in October, except in Dry and Critical years in which the compliance location is moved upstream to Jelly's Ferry. In extreme critically dry conditions Reclamation must reinitiate consultation.

CALSIM II does not determine riverine temperatures or objectives for application in developing its operations of reservoir facilities. Table 14, identifies the flow objectives applied as a surrogate for temperature control objectives. The selection of these flows was based upon the experience of CVP operators. The year type classification used is the SWRCB D-1641 40-30-30 index. These flow schedules are reduced by 25% under critical years as identified under the Shasta Index critical year criteria. The surrogate temperature flow objectives are not used when Shasta storage drops below 2,400 TAF.

Table 14: Temperature Control Objective surrogate flow schedules (CFS)

	April	May	June	July	August	September
Wet (W)	5500	8000	9000	11000	10000	6500
Above Normal (AN)	5500	8000	9000	11000	10000	6500
Below Normal (BN)	5500	8000	9000	11000	10000	6500
Dry (D)	5000	7000	8000	9500	8500	6000
Critical (C)	5000	7000	8000	9500	8500	6000

Sacramento River – USFWS discretionary use of CVPIA 3406(b)(2) - Keswick Release Objective

Source: 1997 CVPIA Administrative Proposal – Management of Section 3406(b)(2) Water

Minimum Flow below Keswick Dam:

A procedure for implementing CVPIA Section 3406(b)(2) based AFRP actions and accounting is incorporated into CALSIM II. This procedure is documented in Appendix G. The procedure maintains a 3406(b)(2) water account and allocates the account based on forecast information and action specific priorities. Refer to the 3406(b)(2) section under Operations Criteria. Management agencies are continuing to refine the rules for implementation of 3406(b)(2), so until further information is available, the schedules shown in Table 15 are assumed for Keswick releases. Stability criteria require November, December, February, March and April flow objectives be at least 90% of preceding month's releases, and January's flow objectives be at least 80% of December's releases. The stability criteria is ignored if the preceding month's release was above 6,000 CFS.

Table 15: Sacramento River Flow Schedules

Period	Lake Shasta end of month storage (MAF)	Keswick Release (CFS)
October - December	Sep storage > 3.0	5500
	Sep storage > 2.9	5250
	Sep storage > 2.8	5000
	Sep storage > 2.7	4750
	Sep storage > 2.6	4500
	Sep storage > 2.5	4250
	Sep storage > 2.4	4000
	Sep storage > 2.3	3750
	Sep storage > 2.2	3500
	Sep storage < 2.2	3250
January	Dec storage > 3.2	5500
	Dec storage > 3.1	5250
	Dec storage > 3.0	5000
	Dec storage > 2.9	4750
	Dec storage > 2.8	4500
	Dec storage > 2.7	4250
	Dec storage > 2.6	4000
	Dec storage > 2.0	3750
	Dec storage > 1.5	3500
	Dec storage < 1.5	3250
February	Jan storage > 3.3	5500
	Jan storage > 3.2	5250
	Jan storage > 3.1	5000
	Jan storage > 3.0	4750
	Jan storage > 2.9	4500
	Jan storage > 2.8	4250
	Jan storage > 2.7	4000
	Jan storage > 2.2	3750
	Jan storage > 1.75	3500
	Jan storage < 1.75	3250
March	Feb storage > 3.4	5500
	Feb storage > 3.3	5250
	Feb storage > 3.2	5000
	Feb storage > 3.15	4750
	Feb storage > 3.1	4500
	Feb storage > 3.05	4250
	Feb storage > 3.0	4000
	Feb storage > 2.4	3750
	Feb storage > 2.0	3500
	Feb storage < 2.0	3250
April	Mar storage > 3.8	5500
	Mar storage > 3.7	5250
	Mar storage > 3.6	5000
	Mar storage > 3.5	4750
	Mar storage > 3.4	4500
	Mar storage > 3.3	4250
	Mar storage > 3.2	4000
	Mar storage > 2.4	3750
	Mar storage > 2.0	3500
	Mar storage < 2.0	3250
May – August	All cases	3250
	Aug storage > 2.0	6000
Sept.	Aug storage < 2.0	4500

Feather River – 1983 DWR, DFG Agreement

Source: 1967 agreement between DWR and DFG, Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife, amended by 1983 FERC re-licensing process

Minimum Flow below Thermalito Diversion Dam:

The 1983 agreement specifies that DWR release a minimum of 600 cfs into the Feather River from the Thermalito Diversion Dam for fishery purposes. This is the total volume of flows from the diversion dam outlet, diversion dam powerplant, and the Feather River Fish Hatchery pipeline.

Minimum Flow below Thermalito Afterbay Outlet:

Table 16 identifies the minimum flow requirement downstream of the Thermalito Afterbay outlet. Table 16 applies if Lake Oroville's surface elevation is greater than 733 feet MSL. Normal runoff is defined as the mean (1911-1960) April through July unimpaired runoff: 1,942 TAF.

Table 16: Feather River Minimum Flow Schedule

Percent of Normal Runoff (%)	Oct – Feb (CFS)	Mar (CFS)	Apr - Sep (CFS)
> 55	1700	1700	1000
< 55	1200	1000	1000

In addition, if during October 15 through November 30, the hourly flow is greater than 2,500 CFS then the flow minus 500 CFS must be maintained until the following March unless the high flow was due to flood control operation or mechanical problems. This requirement is to protect any spawning that could occur in overbank areas during the higher flow rate by maintaining flow levels high enough to keep the overbank areas submerged. In practice, the flows are maintained below 2,500 CFS from October 15 to November 30 to prevent spawning in the overbank areas.

American River - SWRCB D-893

Source: SWRCB D-893

Minimum Flow below Nimbus Dam and at H Street:

D-893 Folsom Reservoir permit conditions require minimum releases from Folsom Dam as shown in Table 17. A critical year is defined when the forecasted unimpaired flow at Folsom between April 1 and September 30 is less than 600 TAF.

Table 17: American River Minimum Flow Schedule

	Normal Years (CFS)	Critical Years
September 16 through December 31	500	25% reduction
January 1 through September 15	250	25% reduction

American River – USFWS discretionary use of CVPIA 3406(b)(2) – Nimbus Release Objective

Source: 1997 CVPIA Administrative Proposal – Management of Section 3406(b)(2) Water

Minimum Flow below Nimbus Dam:

A procedure for implementing CVPIA Section 3406(b)(2) based AFRP actions and accounting is incorporated into CALSIM II. This procedure is documented in Appendix G. The procedure maintains a 3406(b)(2) water account and allocates the account based on forecast information and action specific priorities. Refer to the 3406(b)(2) section in Operations Criteria. Management agencies are continuing to refine the rules for implementation of 3406(b)(2), until further information is available, the schedules shown in Table 18 are assumed for Nimbus releases. Stability criteria require that November, December, and January's flow objectives be at least 80% of the preceding months flow, and that February and March's flow objectives be at least 90% of the preceding month's flow. The stability criteria are ignored if the preceding month's flow is above 4500 CFS.

Table 18: American River Flow Schedules

Period	Folsom Lake end of month storage plus remainder of water year projected Folsom Lake inflow *(when indicated)* (TAF)	Nimbus Release (CFS)
October – December	Sep storage > 500	2500
	Sep storage > 463	2250
	Sep storage > 425	2000
	Sep storage > 350	1750
	Sep storage > 300	1500
	Sep storage > 275	1250
	Sep storage > 265	1000
	Sep storage > 255	750
	Sep storage < 255	500
January	Dec storage > 500	2500
	Dec storage > 425	2250
	Dec storage > 350	2000
	Dec storage > 300	1750
	Dec storage > 290	1500
	Dec storage > 285	1250
	Dec storage > 280	1000
	Dec storage > 275	750
	Dec storage < 275	500

Period	Folsom Lake end of month storage plus remainder of water year projected Folsom Lake inflow *(when indicated)* (TAF)	Nimbus Release (CFS)
February	Jan storage > 600	2500
	Jan storage > 350	2000
	Jan storage > 300	1750
	Jan storage > 225	1250
	Jan storage < 225	500
March	Feb Storage + Inflow > 2850	4500
	Feb Storage + Inflow > 2766	4250
	Feb Storage + Inflow > 2683	4000
	Feb Storage + Inflow > 2600	3750
	Feb Storage + Inflow > 2516	3500
	Feb Storage + Inflow > 2433	3250
	Feb Storage + Inflow > 2350	3000
	Feb Storage + Inflow > 2025	2750
	Feb Storage + Inflow > 1700	2500
	Feb Storage + Inflow > 1500	2250
	Feb Storage + Inflow > 1300	2000
	Feb Storage + Inflow > 1150	1750
	Feb Storage + Inflow > 1000	1500
	Feb Storage + Inflow > 967	1250
	Feb Storage + Inflow > 933	1000
	Feb Storage + Inflow > 900	750
	Feb Storage + Inflow > 700	500
	Feb Storage + Inflow <700	250
April	Mar Storage + Inflow > 2450	4500
	Mar Storage + Inflow > 2383	4250
	Mar Storage + Inflow > 2316	4000
	Mar Storage + Inflow > 2250	3750
	Mar Storage + Inflow > 2183	3500
	Mar Storage + Inflow > 2116	3250
	Mar Storage + Inflow > 2050	3000
	Mar Storage + Inflow > 1800	2750
	Mar Storage + Inflow > 1550	2500
	Mar Storage + Inflow > 1350	2250
	Mar Storage + Inflow > 1150	2000
	Mar Storage + Inflow > 1075	1750
	Mar Storage + Inflow > 1000	1500
	Mar Storage + Inflow > 967	1250
	Mar Storage + Inflow > 933	1000
	Mar Storage + Inflow > 900	750
	Mar Storage + Inflow > 700	500
	Mar Storage + Inflow <700	250
May	Apr Storage + Inflow > 2050	4500
	Apr Storage + Inflow > 1932	4250
	Apr Storage + Inflow > 1816	4000
	Apr Storage + Inflow > 1700	3750
	Apr Storage + Inflow > 1600	3500
	Apr Storage + Inflow > 1500	3250
	Apr Storage + Inflow > 1400	3000
	Apr Storage + Inflow > 1200	2750
	Apr Storage + Inflow > 1000	2500
	Apr Storage + Inflow > 950	2250
	Apr Storage + Inflow > 900	2000
	Apr Storage + Inflow > 850	1750
	Apr Storage + Inflow > 800	1500
	Apr Storage + Inflow > 775	1250
	Apr Storage + Inflow > 750	1000

Period	Folsom Lake end of month storage plus remainder of water year projected Folsom Lake inflow *(when indicated)* (TAF)	Nimbus Release (CFS)
	Apr Storage + Inflow > 725	750
	Apr Storage + Inflow > 600	500
	Apr Storage + Inflow < 600	250
June	May Storage + Inflow > 1800	4500
	May Storage + Inflow > 1750	4250
	May Storage + Inflow > 1700	4000
	May Storage + Inflow > 1600	3750
	May Storage + Inflow > 1500	3500
	May Storage + Inflow > 1400	3250
	May Storage + Inflow > 1300	3000
	May Storage + Inflow > 1266	2750
	May Storage + Inflow > 1133	2500
	May Storage + Inflow > 1000	2250
	May Storage + Inflow > 950	2000
	May Storage + Inflow > 900	1750
	May Storage + Inflow > 800	1500
	May Storage + Inflow > 775	1250
	May Storage + Inflow > 750	1000
	May Storage + Inflow > 725	750
	May Storage + Inflow > 600	500
	May Storage + Inflow < 600	250
July	Jun Storage + Inflow > 1400	2500
	Jun Storage + Inflow > 1300	2250
	Jun Storage + Inflow > 1200	2000
	Jun Storage + Inflow > 1000	1750
	Jun Storage + Inflow > 800	1500
	Jun Storage + Inflow > 775	1250
	Jun Storage + Inflow > 750	1000
	Jun Storage + Inflow > 725	750
	Jun Storage + Inflow > 600	500
	Jun Storage + Inflow < 600	250
August	Jul Storage + Inflow > 1200	2500
	Jul Storage + Inflow > 1100	2250
	Jul Storage + Inflow > 1000	2000
	Jul Storage + Inflow > 900	1750
	Jul Storage + Inflow > 800	1500
	Jul Storage + Inflow > 700	1250
	Jul Storage + Inflow > 600	1000
	Jul Storage + Inflow > 550	750
	Jul Storage + Inflow > 500	500
	Jul Storage + Inflow < 500	250
September	Aug Storage + Inflow > 1200	2500
	Aug Storage + Inflow > 1100	2250
	Aug Storage + Inflow > 1000	2000
	Aug Storage + Inflow > 900	1750
	Aug Storage + Inflow > 800	1500
	Aug Storage + Inflow > 700	1250
	Aug Storage + Inflow > 600	1000
	Aug Storage + Inflow > 550	750
	Aug Storage + Inflow > 500	500
	Aug Storage + Inflow < 500	250

Lower Sacramento River - SWRCB D-1641

Source: SWRCB D-1641

Minimum Flow near Rio Vista:

Table 19 identifies the minimum flow required on the Sacramento River at Rio Vista under the Water Quality Control Plan, SWRCB D-1641. The year type classification used is the D-1641 40-30-30 index.

Table 19: Sacramento River at Rio Vista Flow Schedule (CFS)

	Wet (W)	Above Normal (AN)	Below Normal (BN)	Dry (D)	Critical (C)
Sep	3,000	3,000	3,000	3,000	3,000
Oct	4,000	4,000	4,000	4,000	3,000
Nov-Dec	4,500	4,500	4,500	4,500	3,500

Mokelumne River –FERC 2916-029

Source: 1996 Lower Mokelumne River Project Joint Settlement Agreement

Minimum Flow below Camanche Dam:

Table 20 identifies 4 year type classes. Combined Pardee Reservoir and Camanche Reservoir storage on November 5 (forecasted if not actual) is used to classify the Oct – Mar period, and April forecasted unimpaired runoff for the Apr – Sep period is used to classify the Apr – Sep period. If combined Pardee Reservoir and Camanche Reservoir storage is forecasted to be less than 200 TAF, than the whole year is classified as Critically Dry. Table 21 identifies the schedule of minimum flows below Camanche Dam for each of the year type classifications. For the months of April, May and June during the Below Normal, Normal and Above year types, additional release of 50, 100, 150 or 200 CFS is required if the combined Pardee Reservoir and Camanche reservoir storage is within 40, 30, 20 or 10 TAF, respectively, of maximum allowable storage at the end of the prior month.

Table 20: Mokelumne River Year Type Classification

	Normal/Above	Below Normal	Dry	Critically Dry
Oct – Mar (Pardee/Camanche Storage)	Max Allowable	Max Allowable to 400 TAF	399 TAF to 270 TAF	269 TAF or less
Apr – Sep (Unimpaired Runoff)	890 TAF or More	889 TAF to 500 TAF	499 TAF to 300 TAF	299 TAF or less

Table 21: Mokelumne River below Camanche Dam Minimum Flow Schedule (CFS)

Life Stage	Period(s)	Normal/Above	Below Normal	Dry	Critically Dry
Adult Immigration	10/1 – 10/15	325	250	220	100
Spawn/ Incubation	10/16 – 12/31	325	250	220	130
Incubation/ Alevin	1/1 – 2/28	325	250	220	130
Fry Rearing	3/1 – 3/31 4/1 – 4/30	325	250	220	130
Fry Rearing/ Junvenile Rearing/ Outmigration	5/1 – 5/31 6/1 - 6/30	325	250	220 100	100
Oversummer	7/1 – 9/30	100	100	100	100

Minimum Flow below Woodbridge Diversion Dam:

Table 22 identifies the schedule of minimum flows below Woodbridge Diversion Dam for each of the year type classifications. The additional release criteria for releases from Camanche Dam apply at Woodbridge Diversion Dam as well.

Table 22: Mokelumne River below Woodbridge Diversion Dam Minimum Flow Schedule (CFS)

Life Stage	Period(s)	Normal/Above	Below Normal	Dry	Critically Dry
Adult Immigration	10/1 – 10/15	100	100	80	15
Spawn/ Incubation	10/16 – 12/31	100	100	80	75
Incubation/ Alevin	1/1 – 2/28	100	100	80	75
Fry Rearing	3/1 – 3/31 4/1 – 4/30	100 150	100 150	80 150	75
Fry Rearing/ Junvenile Rearing/ Outmigration	5/1 – 5/31 6/1 - 6/30	300	200	150 20	15
Oversummer	7/1 – 9/30	25	20	20	15

Stanislaus River – 1987 USBR, DFG Agreement, and USFWS discretionary use of CVPIA 3406(b)(2) – Goodwin Release Objective

Source: 1987 USBR, DFG Agreement and New Melones Interim Operations Plan

Minimum Flow below Goodwin Dam:

Depending on the Fishery allocation (0 – 467 TAF/Yr) under the New Melones Interim Operations Plan, the combined release at Goodwin Dam is managed under the minimum and pulse flow schedules shown in Table 23. Refer to the New Melones Interim Operations Plan section in Operations Criteria.

A procedure for implementing CVPIA Section 3406(b)(2) based AFRP actions and accounting is incorporated into CALSIM II. This procedure is documented in Appendix G. The 1987 USBR, DFG Agreement allocates less water to the Stanislaus fisheries (98-302 TAF/Yr). CVPIA 3406(b)(2) water is prededicated by operations under the New Melones Interim Operations Plan. The extent to which 3406(b)(2) water is prededicated is the increase in allocation between the 1987 agreement and the plan.

Table 23: Stanislaus River Minimum and Pulse Flow Schedules

Annual Fishery Allocation (TAF)	0	83	172	182	275	410	467
Minimum Flow Schedules (CFS)							
January	0	125	250	275	300	350	400
February	0	125	250	275	300	350	400
March	0	125	250	275	300	350	400
April	0	250	300	300	900	1500	1500
May	0	250	300	300	900	1500	1500
June	0	0	200	200	250	800	1500
July	0	0	200	200	250	300	300
August	0	0	200	200	250	300	300
September	0	0	200	200	250	300	300
October	0	110	200	250	250	350	350
November	0	200	250	275	300	350	400
December	0	200	250	275	300	350	400
Pulse Flow Schedules (CFS)							
Apr 15 – May 16	0	500	1500	1500	1500	1500	1500

Stanislaus River – D-1422

Source: SWRCB D-1422

Minimum Dissolved Oxygen:

CALSIM II has neither the ability to predict nor adjust operations for dissolved oxygen. D-1422 requires that water be released from New Melones to maintain a minimum dissolved oxygen concentration in the Stanislaus River of 7 mg/l as measured near Ripon. As a surrogate, specific volumes of release are made, as required, per the New Melones Interim Operations Plan, to insure this criteria is met. The surrogate volumes are shown in Table 24. Refer to the New Melones Interim Operations Plan section in Operations Criteria.

Table 24: Surrogate Dissolved Oxygen Release Volumes

Month	Release Volume (TAF)
June	13.2
July	16.2
August	16.4
September	14.3

Merced River – Davis-Grunsky

Source: 1967 Davis-Grunsky Contract No D-GGR17

Minimum Flow below Crocker-Huffman Diversion Dam:

Under a Davis-Grunsky agreement with the California Department of Water Resources for grant funding of portions of the Merced River Development Plan, MID must provide 180 to 220 CFS of flow downstream of the Crocker-Huffman Diversion Dam to support Chinook salmon spawning runs. The schedule of this requirement is shown in Table 25.

Merced River – FERC 2179

Source: FERC 2179

Minimum Flow at Shaffer Bridge:

Under its FERC license, MID must operate Lake McClure to provide minimum flows at Shaffer Bridge. The schedules of minimum flows are shown in Table 25. A dry year is defined by the FERC license as a forecasted April through July inflow to Lake McClure less than 450 TAF, as forecasted by DWR.

Merced River – Cowell Agreement

Source: 19?? Cowell Agreement

Minimum Flow below Crocker-Huffman Diversion Dam:

Due to water rights adjudication (Cowell Agreement), Merced must make available, below Crocker-Huffman diversion Dam an amount of water that could then be diverted from the river at a number of private ditches between Crocker-Huffman Diversion Dam and Shaffer Bridge. This amount is shown in Table 25.

For the period of Oct – Feb, the water rights entitlement is limited to 50 cfs or the natural flow of the Merced River (inflow to Lake McClure), whichever is less. If the natural flow of the Merced River falls below 1,200 cfs in the month of June, the entitlement flows are reduced accordingly from that day: 225 cfs flow for next 31 days; 175 cfs flow for next 31 days; 150 cfs for next 30 days; 50 cfs for the remainder of September.

Table 25: Merced River Minimum Flow Schedules (CFS)

Month	Davis-Grunsky Minimum Flow below Crocker-Huffman Diversion Dam	FERC 2179 Minimum Flow at Shaffer Bridge		Cowell Agreement Entitlement
		Normal Year	Dry Year	
Oct 1-15	0	25	15	50
Oct 16-31	0	75	60	50
Nov	180-220	100	75	50
Dec	180-220	100	75	50
Jan	180-220	75	60	50
Feb	180-220	75	60	50
Mar	180-220	75	60	100
Apr	0	75	60	175
May	0	75	60	225
Jun	0	25	15	250
Jul	0	25	15	225
Aug	0	25	15	175
Sep	0	25	15	150

Tuolumne River - FERC 2299-024

Source: 1995 Settlement Agreement

Minimum Flow at LaGrange Bridge:

Table 26 identifies the 10 year type classifications for the Tuolumne River. Only 7 of these classifications have distinctly different minimum flow schedules Table 27 identifies these 7 minimum flow schedules.

Table 26: Tuolumne River Year Type Classification

	San Joaquin Basin 60-20-20 Index (TAF)
Critical and Below	<1500
Median Critical	1500
Intermediate Critical/Dry	2000
Median Dry	2200
Intermediate Dry/Below Normal	2400
Median Below Normal	2700
Intermediate Below Normal/ Above Normal	3100
Median Above Normal	3100
Intermediate Above Normal/ Wet	3100
Median Wet/ Maximum	3100

Table 27: Tuolumne River Minimum Flow Schedules

	Critical and Below	Median Critical	Inter-mediate Critical/ Dry	Median Dry	Inter-mediate Dry/ Below Normal	Median Below Normal	Inter-mediate Below Normal/ Above Normal and Above
Annual Volume (AC-FT)	94,000	103,000	117,016	127,507	142,502	165,002	300,923
October 1 – 15 (CFS)	100	100	150	150	180	200	300
Attraction Pulse Flow (AC-FT)	None	None	None	None	1,676	1,736	5,950
October 16- May 31 (CFS)	150	150	150	150	180	175	300
Out migration Pulse Flow (AC-FT)	11,091	20,091	32,619	37,060	35,920	60,027	89,882
June 1 – September 30 (CFS)	50	50	50	75	75	75	250

San Joaquin River – D-1641

Source: SWRCB D-1641

Maximum Salinity near Vernalis:

The maximum salinity near Vernalis was originally defined in SWRCB D-1422. SWRCB D-1641 provisions have revised this requirement. CALSIM II does not have the capability to predict salinity concentration at Vernalis, except through a simplified empirically blending of flows and their associated assumed salinity concentrations. D-1641 requires salinity near Vernalis to be less than 0.7 EC for April - August and less than 1.0 EC September – March. Releases are made from New Melones, as required, per the New Melones Interim Operations Plan, to insure this criteria is met. Refer to the New Melones Interim Operations Plan section in Operations Criteria.

San Joaquin River – D-1641

Source: SWRCB D-1641

Minimum Flow near Vernalis:

Table 28 identifies the minimum flow schedules required at Vernalis under SWRCB D-1641. D-1641 also has a higher pulse flow requirement specifically for the Apr 15 – May 16 period which is not included. D-1641 provides for an interim evaluation period, use of the Vernalis Adaptive Management Program. The year type classification used is the D-1641 60-20-20 index. Release are made from New Melones, as required, per the New Melones Interim Operations Plan, to insure this criteria is met. Refer to the New Melones Interim Operations Plan section in Operations Criteria.

Table 28: San Joaquin River at Vernalis Minimum Flow Schedule (CFS)

Period	Condition	Wet (W) and Above Normal (AN)	Below Normal (BN) and Dry (D)	Critical (C)
February – June		2,130	1,420	710
	When X2 is required to be at or West of Chipps Island	3,420	2,280	1,140

San Joaquin River – Vernalis Adaptive Management Program

Source: 1998 San Joaquin River Agreement

Minimum Flow near Vernalis:

The Vernalis Adaptive Management Program specifies pulse period (Apr 15 – May 16) flow targets on the San Joaquin River near Vernalis. The meeting of these flow targets is supported through water purchases. These water purchases are described under the San Joaquuin River Agreement section under Operations Criteria. In addition, the Vernalis Adaptive Management Program specifies export reductions concurrent with the flow targets . This is described under the Export Restrictions section.

The pulse period, Apr 15 – May 16, VAMP flow targets are shown in Table 29. Based upon a forecast of operations, the "existing" flow is determined and the VAMP target selected accordingly.

In addition, each year is identified with a numeric adjunct, 1 – 5, corresponding to the SWRCB D-1641 60-20-20 year type classifications, Critical, Dry, Below Normal, Above Normal and Wet respectively. In any year when the sum of the current year's and previous year's year types total 7 or greater, the VAMP flow target used will be the next step higher than that determined by use the "existing" flow criteria. In any year when the sum of the current year's and previous two year's year types total 4 or less no releases for VAMP are required.

Table 29: San Joaquin River Minimum Flows (VAMP)

Existing Flow (CFS)	VAMP Target Pulse Flow (CFS)
0 – 1,999	2,000
2,000 – 3,199	3,200
3,200 – 4,449	4,450
4,450 – 5,699	5,700
5,700 – 7,000	7,000
> 7,000	Provide stable flow to the extent possible

Sacramento River-San Joaquin River Delta – SWRCB D-1641

Source: SWRCB D-1641

Delta Outflow Index (Flow and Salinity):

All flow based Delta outflow requirements included in SWRCB D-1641 are included in these assumptions, however not all salinity based Delta outflow requirements are included. CALSIM II is not capable of predicting salinities in the Delta. Instead, empirically based equations and models are used to relate interior salinity conditions with Delta outflow requirements. The Kimmerer-Monismith equation is used to predict and interpret the location of "X2". DWR's new Artificial Neural Network (ANN) technology (refer to Appendix D) is used to predict and interpret salinity conditions at the Emmaton, Jersey Point, Rock Slough and Collinsville stations.

Table 30 identifies the primary flow based requirement for Delta Outflow. For the period of Feb – Jun the X2 standard is used. The term "8RI" refers to the eight river index which is the sum of the unimpaired forecast for: 1) Sacramento River at Bend Bridge; 2) Feather River at Lake Oroville; 3) Yuba River at Smartsville; 4) American River at Folsom Lake; 5) Stanislaus River at New Melones Reservoir; 6) Tuolumne River at Don Pedro Reservoir; 7) Merced River at Exchequer Reservoir; and 8) San Joaquin River at Millerton Lake.

<u>Table 30: Minimum Delta Outflow Schedule (CFS)</u>

	Wet	Above Normal	Below Normal	Dry	Critical
Jan	4,500 (6,000 if Dec 8RI > 800 TAF)				
Feb-Jun	X2 Standard				
Jul	8,000		6,500	5,000	4,000
Aug	4,000			3,500	3,000
Sep	3,000				
Oct	4,000				3,000
Nov – Dec	4,500				3,500

There are three ways to meet the X2 (2.64 mmhos) standard: 1) 2.64 mmhos or less 3 day running average EC at compliance location; 2) 2.64 mmhos or less 14 day running average EC at compliance location; or 3) Daily Net Delta Outflow equivalent (Collinsville = 7,100 CFS; Chipps Island = 11,400 CFS; Port Chicago = 29,200 CFS).

At the Collinsville location, X2 compliance is required February through June. If the Sacramento River Index (SRI) is less than 8.1 MAF (90% exceedence), the Collinsville standard does not apply in May and June and the minimum 14 day running average of 4,000 CFS is used.

At the Chipps Island location, X2 compliance is required for at least the number of days shown in Table 31. The required days are linearly interpolated between the values shown in the table. The same 90% exceedence exception for Collinsville applies here as well.

<u>Table 31: Required X2 Compliance days at Chipps Island (days)</u>

Previous Month's 8RI (TAF)	Feb	Mar	Apr	May	Jun

Previous Month's 8RI (TAF)	Feb	Mar	Apr	May	Jun
<= 500	0	0	0	0	0
750		0	0	0	0
800	0				
1000	28	12	2	0	0
1250	28	31	6	0	0
1500	28	31	13	0	0
1750	28	31	20	0	0
2000	28	31	25	1	0
2250	28	31	27	3	0
2500	28	31	29	11	1
2750	28	31	29	20	2
3000	28	31	30	27	4
3250	28	31	30	29	8
3500	28	31	30	30	13
3750	28	31	30	31	18
4000	28	31	30	31	23
4250	28	31	30	31	25
4500	28	31	30	31	27
4750	28	31	30	31	28
5000	28	31	30	31	29
5250	28	31	30	31	29
>=5250	28	31	30	31	30

When "triggered", at the Roe Island (Port Chicago) location, X2 compliance is required for at least the number of days shown in Table 32. This requirement is "triggered" if the 14-day running average EC at Roe Island is less than or equal to 2.64 mmhos on the last day of the previous month. The required days are linearly interpolated between the values shown in the table. The same 90% exceedence exception for Collinsville applies here as well.

Table 32: Required X2 Compliance days at Roe Island (days)

Previous Month's 8RI (TAF)	Feb	Mar	Apr	May	Jun
0	0	0	0	0	0
250	1	0	0	0	0
500	4	1	0	0	0
750	8	2	0	0	0
1000	12	4	0	0	0
1250	15	6	1	0	0
1500	18	9	1	0	0
1750	20	12	2	0	0
2000	21	15	4	0	0
2250	22	17	5	1	0
2500	23	19	8	1	0
2750	24	21	10	2	0
3000	25	23	12	4	0
3250	25	24	14	6	0
3500	25	25	16	9	0
3750	26	26	18	12	0
4000	26	27	20	15	0
4250	26	27	21	18	1

Previous Month's 8RI (TAF)	Feb	Mar	Apr	May	Jun
4500	26	28	23	21	2
4750	27	28	24	23	3
5000	27	28	25	25	4
5250	27	29	25	26	6
5500	27	29	26	28	9
5750	27	29	27	28	13
6000	27	29	27	29	16
6250	27	30	27	29	19
6500	27	30	28	30	22
6750	27	30	28	30	24
7000	27	30	28	30	26
7250	27	30	28	30	27
7500	27	30	29	30	28
7750	27	30	29	31	28
8000	27	30	29	31	29
8250	28	30	29	31	29
8500	28	30	29	31	29
8750	28	30	29	31	30
9000	28	30	29	31	30
9250	28	30	29	31	30
9500	28	31	29	31	30
9750	28	31	29	31	30
10000	28	31	30	31	30
>10000	28	31	30	31	30

Table 33, Table 34, Table 35, and Table 36 show the salinity requirements at the Emmaton, Jersey Point, Rock Slough and Collinsville compliance stations. The 40-30-30 year type classification defined in D-1641 is used. These requirements are interpreted by use of the ANN logic and applied as Delta outflow requirements. The standards shown here may be buffered (lower) or ramped (preceded) when applied in the model in ensure compliance with the standard. The ANN and implementation is fully described in Appendix D.

Table 33: Sacramento River at Emmaton Maximum Salinity Requirement

	Apr 1 to Date Shown 0.45 mmhos EC	EC from Date Shown to Aug 15 (mmhos)
Wet	Aug 15	---
Above Normal	July 1	0.63
Below Normal	June 20	1.14
Dry	June 15	1.67
Critical	----	2.78

Table 34: San Joaquin River at Jersey Point Maximum Salinity Requirement

	Apr 1 to Date Shown 0.45 mmhos EC	EC from Date Shown to Aug 15 (mmhos)
Wet	Aug 15	---
Above Normal	July 1	---
Below Normal	June 20	0.74
Dry	June 15	1.35
Critical	----	2.20

Table 35: Rock Slough Maximum Salinity Requirement

	Number of Days Each Calendar Year < 150 mg/l Chloride
Wet	240
Above Normal	190
Below Normal	175
Dry	165
Critical	155

Table 36: Sacramento River at Collinsville Maximum Salinity Requirement

	EC (mmhos)
Oct	19.0
Nov – Dec	15.5
Jan	12.5
Feb – Mar	8.0
Apr – May	11.0

Delta Cross Channel Gate Operations:

Under D-1641, the Cross Channel Gate are closed for 45 days through the Nov – Jan period for fishery protection, as follows: 1) Nov, 10 days closed; 2) Dec, 15 days closed; and 3) Jan, 20 days closed. The Cross Channel Gates are closed Feb – May 20, and closed for 14 days between May 21 – Jun 15. In addition, to prevent channel scour, whenever Freeport flows are sustained above 25,000 CFS the gates are closed.

Delta Exports:

Under D-1641 the combined export of the CVP Tracy Pumping Plant and SWP Banks Pumping Plant is limited to a percentage of 3-day running average Delta inflow or flow in the San Joaguin River at Vernalis as shown in Table 37.

Table 37: Export Restrictions

	Export/Inflow Ratio Restriction	Export/San Jaoquin River Flow Ratio Restriction
Oct – Jan	<= 65 %	
Feb	35 % (If Jan 8RI >= 1.5 MAF) 45 % (If Jan 8RI <= 1.0 MAF) (linearly interpolate inbetween)	
Apr 15 – May 16	<= 35%	< =100% (1,500 CFS minimum allowable export)
May 16 – Jun	<= 35%	
Jul – Sep	<= 65%	

Sacramento River-San Joaquin River Delta – USFWS discretionary use of CVPIA 3406(b)(2)
Source: 1999 Department of Interior

Delta Exports:

A procedure for implementing CVPIA Section 3406(b)(2) based actions and accounting is incorporated into CALSIM II. This procedure is documented in Appendix G. The procedure maintains a 3406(b)(2) water account and allocates the account based on forecast information and action specific priorities. Only CVP Export at Tracy Pumping Plant and SWP Wheeling for CVP Export is restricted in various degrees based upon the 3406(b)(2) water allocation. The specific actions and scheduling of implementation are briefly described under the CVPIA 3406(b)(2)/Operations Criteria section. Because 3406(b)(2) only applies to the CVP, full application of Delta export reductions requires some mechanism for cooperation of the SWP at Banks Pumping Plant; this is discussed in the sections on the CALFED Environmental Water Account (EWA).

One specific action for 3406(b)(2) implementation is the Vernalis Adaptive Management Program specified export reductions (Apr 15 – May 16). These reductions are implemented concurrent with pulse period flow targets at Vernalis. The pulse period, Apr 15 – May 16, VAMP export restrictions are shown in Table 38. The VAMP target pulse flow rules are described under the Minimum Flow at San Joaquin near Vernalis section.

Table 38: Restriction of Total Export, VAMP Criteria

VAMP Target Pulse Flow (CFS)	VAMP Restriction of Total Exports (CFS)
2,000	1,500
3,200	1,500
4,450	1,500
5,700	2,250
7,000	1,500 or 3,000

Sacramento River-San Joaquin River Delta – CALFED Fisheries Agencies discretionary use of EWA
Source: 1999 CALFED ROD, Environmental Water Account

Delta Exports:

A procedure for implementing EWA based actions and asset expenditure is incorporated into CALSIM II. This procedure is documented in Appendix H. The procedure maintains a water account and allocates the account based on forecast information and action specific priorities. The account is maintained through exercise of EWA assets. The specific actions and scheduling of implementation of actions are briefly described under the CALFED Environmental Water Account/Operations Criteria section.

One specific action for EWA is the Vernalis Adaptive Management Program specified export reductions (Apr 15 – May 16), shown in Table 38 and discussed in the preceding Delta Export/3406(b)(2) section. The EWA allows for SWP cooperation for full implementation of Delta Export reductions in conjunction with use of the 3406(b)(2) water allocation of the CVP.

OPERATIONS CRITERIA

Upper Sacramento River – Discretionary Operations for Navigation Control Point

Source: CVP-OCAP 1992

Flow Objective for Navigation (Wilkins Slough):

The navigational flow objective, at Wilkins Slough, of 5,000 CFS has been used as the basis for designing many of the pumping stations along the Sacramento River. At flows below 5,000 CFS, diverters have reported increased pump cavitation as well as greater pumping head requirements. Diverters are able to operate for an extended time at flows as low as 4,000 CFS at Wilkins Slough, but pumping operations are affected, and some pumps become inoperable at flows lower than this. On a daily operating basis, flows may drop as low as 3,500 CFS for short periods while changes are made in Keswick releases to reach target levels at Wilkins Slough, but using the 3,500 CFS rate as a target level for an extended period would have major impacts on diverters.

No criteria have been established that specifies when the flow criteria should be relaxed to conserve water in Trinity Reservoir or Lake Shasta for future times when water supplies are not sufficient to meet contractual delivery and other operational requirements. In CALSIM II an arbitrary variable target based upon storage conditions in Lake Shasta is used.

American River – SAFCA, Interim Reoperation of Folsom Dam

Source: SAFCA Interim Reoperation of Folsom Dam and Reservoir, Final EIR, 1994

Folsom Dam Flood Control:

Folsom Reservoir is operated in accordance with the 400-670 TAF variable flood control diagram described in the *Interim Reoperation of Folsom Dam and Reservoir, Final EIR,* December, 1994. This operation recognizes flood control capability provided by the available storage capacity in three upstream reservoirs (French Meadows Reservoir, Hell Hole Reservoir and Union Valley Reservoir). The current "creditable" upstream storage space allows the Folsom Reservoir flood control reservation to be varied from 400 TAF to 670 TAF.

Table 39 identifies the schedules of end-of-month required flood control space in Folsom Lake as a function of upstream creditable space. Upstream Creditable Space is the sum of end-of-month available storage capacity in French Meadows Reservoir, Hell Hole Reservoir and Union Valley Reservoir up to 45, 80, and 75 TAF respectively. This table assumes that the modifications to Folsom Dam's outlets have not been included. Appropriate interpretation of Folsom Dam flood control requirements requires a definition of these upstream reservoir operations under the appropriate level of development.

Table 39: Folsom Lake Flood Control

Upstream Creditable Space	End-of-month Required Flood Control Space in Folsom Lake (TAF) *(linear interpolation for intermediate values)*						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr
0	350	670	670	670	670	405	175
100	290	575	575	575	575	375	175
130	255	500	500	500	500	340	175
150	255	450	450	450	450	320	175
175	255	425	425	425	425	305	175
200	255	400	400	400	400	300	175

American River – Discretionary Operations Criteria under SWRCB D-893

Source: unsupported

Flow below Nimbus Dam:

Folsom Lake operates for water supply, salinity control, fisheries related requirements and enhancement, flood control and hydropower. CALSIM II lacks sophisticated rules for hydropower related operations. A flow objective below Nimbus Dam is used to operate Folsom Dam in a surrogate fashion balancing all these benefits. Table 40 identifies the operation criteria which was developed based upon historical Nimbus release data from 1976 – 2000. The discretionary releases based on these flow schedules are capped at 3,000 CFS. This flow schedule is the basis of operation from which the resulting discretionary use of CVPIA 3406(b)(2) water is developed.

Table 40: Nimbus Dam Discretionary Operations Criteria

Period	Folsom Lake end of month storage plus remainder of water year projected Folsom Lake inflow *(when indicated)* (TAF)	Nimbus Release (CFS) *(linear interpolate for intermediate values)*
October	Sep storage > 750 Sep storage > 700 Sep storage > 600 Sep storage > 400 Sep storage > 200 Sep storage > 100	2750 1750 1500 750 600 500
November	Oct storage > 700 Oct storage > 650 Oct storage > 600 Oct storage > 400 Oct storage > 150	2500 1300 1150 800 500
December	Nov storage > 700 Nov storage > 650 Nov storage > 600 Nov storage > 300 Nov storage < 200 Nov storage < 150	3000 1500 1400 1000 500 500
January	Dec storage > 700 Dec storage > 650 Dec storage > 600 Dec storage > 500 Dec storage < 400 Dec storage < 300 Dec storage < 250	3000 1750 1500 1200 1000 750 500
February	Jan storage > 725 Jan storage > 700 Jan storage > 650 Jan storage > 600 Jan storage > 500 Jan storage < 400 Jan storage < 300 Jan storage < 200	3000 2500 1700 1500 1100 800 550 500
March	Feb Storage + Inflow > 2500 Feb Storage + Inflow > 1750 Feb Storage + Inflow > 1000 Feb Storage + Inflow > 500	3500 1500 750 250
April	Mar Storage + Inflow > 2250 Mar Storage + Inflow > 1500 Mar Storage + Inflow > 1000 Mar Storage + Inflow > 500	3000 1750 750 250
May	Apr Storage + Inflow > 2000 Apr Storage + Inflow > 1500 Apr Storage + Inflow > 1000 Apr Storage + Inflow > 500	4500 2250 1000 500

Period	Folsom Lake end of month storage plus remainder of water year projected Folsom Lake inflow *(when indicated)* (TAF)	Nimbus Release (CFS) *(linear interpolate for intermediate values)*
June	May Storage + Inflow > 1600 May Storage + Inflow > 1000 May Storage + Inflow > 250	4500 1500 1000
July	Jun Storage + Inflow > 1500 Jun Storage + Inflow > 1000 Jun Storage + Inflow > 750 Jun Storage + Inflow > 250	4500 2500 1750 750
August	Jul Storage + Inflow > 1000 Jul Storage + Inflow > 750 Jul Storage + Inflow > 500 Jul Storage + Inflow > 100	2500 1500 1000 750
September	Aug Storage + Inflow > 1000 Aug Storage + Inflow > 500 Aug Storage + Inflow > 150	2500 1000 500

American River – Sacramento Water Forum

Source: 1999 Sacramento Water Forum EIR/S

Sacramento Water Forum Mitigation Water:

Under the Sacramento Water Forum, any diversions from the American River for Placer County Water Agency (PCWA) or the City of Roseville in excess of their "1995 Baseline" diversion amounts may require "bucket for bucket" replacement under "mitigation" water operations criteria in the Water Forum Agreement. The "1995 Baseline" diversion amounts from the American River for PCWA and the City of Roseville are 8.5 TAF/Yr and 19.8 TAF/Yr respectively. Under four-party arrangements (specific purveyor receiving mitigation, USBR, Water Forum environmental caucus, downstream consumptive user), "mitigation" water is released from PCWA's Middle Fork Project (MFP) in excess of all other normal release operations for maintaining flow conditions in the lower American River. "Mitigation" water is passed (or reoperated according to agreement) through Folsom Dam and the lower American River and recovered for consumptive use downstream of the American River.

The Water Forum Agreement provides for surface diversion reductions from the American River in "dry" through "driest" years. "Driest" year diversions are no greater than the "1995 Baseline" defined by the Water Forum participants. A "Dry" year is defined as a year in which the forecasted Folsom Unimpaired Inflow (FUI) for Mar – Nov (modeled as Mar 1 – Sep 30 plus 60 TAF) is less than 950 TAF. A "Driest" year is defined as a year in which the forecasted Folsom Unimpaired Inflow (FUI) for Mar – Nov is less than 400 TAF. The PCWA and City of

Roseville purveyor specific information from the Water Forum Agreement is presented in Table 41. The assumptions for each purveyor used in this modeling are described in detail in Appendix B.

Table 41: Water Forum Mitigation Water Schedules

	PCWA		City of Roseville	
	Annual Diversion Amount (TAF/Yr)	Associated Mitigation Water (TAF/Yr)	Annual Diversion Amount (TAF/Yr)	Associated Mitigation Water (TAF/Yr)
"1995 Baseline" *(negotiated)*	8.5	n/a	19.8	n/a
Water Forum Agreement				
$FUI_{Mar-Nov}$ > 950 TAF	35.5	0.0	54.9	0.0
400 TAF < $FUI_{Mar-Nov}$ < 950 TAF	35.5	linearly interpolated	linearly interpolated	linearly interpolated
$FUI_{Mar-Nov}$ < 400 TAF	35.5	27.0	39.8	20.0

In implementing the operation of "mitigation" water:

- Mitigation water is released at a constant rate during the months of March through September.
- MFP baseline releases (the releases from the MFP that would have normally occurred without prior or current mitigation water releases) are maintained for a period starting with the mitigation water release operation and ending with the start of the mitigation water "refill" operation.
- The mitigation water "refill" operation begins as soon as Folsom Reservoir storage reaches its maximum allowable under flood control operations. The MFP is allowed to "refill" the MFP storage deficit from preceding mitigation water release operations by storing inflow and reducing power releases that are not needed for any other downstream requirement.
- If refill of the MFP storage deficit is not completely achieved by the time a subsequent mitigation water release operation commences, the preceding unrefilled deficit is carried through until the next "refill" operation begins.
- If mitigation water releases would reduce forecasted MFP storage to lower than minimum pool requirements, or prevent MFP operations from maintaining flow requirements or "1995 baseline" diversion, mitigation water release operations and diversions above the "1995 baseline" must cease.

Stanislaus River – 1997 New Melones Interim Operations Plan

Source: 1997 New Melones Interim Operations Plan

Minimum Flow below Goodwin Dam:

The New Melones Interim Operations Plan documents a negotiated basis for allocation of supply to four purposes: fishery, water quality, instream flow and water supply. In this discussion fishery refers to flow requirements of the 1987 USBR, DFG Agreement, and prescriptive use of CVPIA 3406(b)(2); water quality refers to SWRCB D-1641 maximum salinity requirements at Vernalis; instream flow refers to D-1641 minimum flow requirements at Vernalis (not including pulse flows during the Apr 15- May 16 period or VAMP); and water supply refers to CVP contractors, Stockton East WD and Central San Joaquin.

Table 42 identifies the annual water supply classifications. Table 43 identifies the maximum allocation of annual water supply to each of the purposes. Based on the value of the End-of-Feb New Melones Storage plus Mar – Sep Forecast the allocation ranges in Table 43 are linearly interpolated. The resulting allocation is accounted for as releases to the Stanislaus River measured at Goodwin Dam. The allocations for fisheries, water quality and instream flows is interpreted as follows: 1) All releases up to the amount of the fishery pattern are included in the annual Fishery allocation; 2) All release up to the amount of the D-1641 Vernalis Minimum Flow Requirement, excluding the amount of Fishery allocation, are included in the annual Bay-Delta allocation; and 3) All releases up to the amount of the Vernalis water quality requirement, excluding the amount of Fishery and Bay-Delta allocations, are included in the annual Vernalis Water Quality allocation.

Additional releases are required if necessary to meet the the D-1422 minimum dissolved oxygen content requirement. Releases from Goodwin Dam to the Stanislaus River (except for flood control) can not exceed 1,500 CFS.

Table 42: Annual Water Supply Categories

	End-of-Feb New Melones Storage plus Mar – Sep Forecast (TAF)
Low	0 – 1,400
Medium – Low	1,400 – 2,000
Medium	2,000 – 2,500
Medium – High	2,500 – 3,000
High	3,000 – 6,000

Table 43: Annual Water Supply Allocations (TAF)

	Fishery	Vernalis Water Quality	Bay-Delta (D-1641 Vernalis Minimum Flow Requirement)	CVP Contractors
Low	0 – 98	0 – 70	0	0

Medium – Low	98 – 125	70 – 80	0	0
Medium	125 – 345	80 – 175	0	0 – 59
Medium – High	345 – 467	175 – 250	75	90
High	467 – 467	250 – 250	75	90

San Joaquin River – San Joaquin River Agreement

Source: 1998 San Joaquin River Agreement and related "Diversion Agreement"

Flow near Vernalis:

The San Joaquin River Agreement provides for the implementation of the Vernalis Adaptive Management Program (VAMP). VAMP includes pulse period (Apr 15 – May 16) flow targets on the San Joaquin River near Vernalis and associated Delta export reductions. The flow targets and export reductions are detailed under the previous discussion of regulatory requirements on the San Joaquin River and the Delta. This section discusses the water purchases under the San Joaquin River Agreement for supporting VAMP.

Under the agreement, annually, the San Joaquin River Group Authority (SJRGA) members (Modesto Irrigation District (MID), Turlock Irrigation District (TID), Merced Irrigation District (Merced), South San Joaquin Irrigation District (SSJID), and Oakdale Irrigation District(OID)), during the pulse period (Apr 15 – May 16), provide water to meet the VAMP target flow or 110 TAF, whichever is less. The SJRGA has executed a "Division Agreement" which specifies amount and order of the individual contributions of water by its members (Table 44). The agreement assumes that the Stanislaus River is operated in accordance with the New Melones Interim Operations Plan (see preceding section) and that releases under the plan are included in the "existing" flow at Vernalis (see San Joaquin River – Vernalis Adaptive Management Program section).

An additional 12.5 TAF of water above "existing" flow in the Merced River is provided by Merced in October of all years. Also, an additional 15.0 TAF of water and up to 11.0 TAF of any unused OID VAMP water is made available to Reclamation by OID.

Table 44: Division Agreement Schedule (TAF)

	Entity	First Tier	Second Tier	Third Tier	Fourth Tier
First	Merced	25	11.5	8.5	10
Second	OID/SSJID	10	4.6	3.4	4
Third	Exchange Contactors	5	2.3	1.7	2
Fourth	MID/TID	10	4.6	3.4	4
Total		50	23	17	20

SWP Water Allocation – FRSA Contract specific

Source: Feather River Service Area (FRSA) Contracts

North-of-Delta (FRSA) Allocation:

Under contracts between DWR and each of the FRSA diverters, deliveries can be reduced, due to "Drought," by no more than 50% in any one year, and no more than 100% in any series of seven (7) consecutive years. In addition, reductions can not exceed the percentages for the reduction in annual entitlements for water to be put to agricultural use by water supply contractors in the San Joaquin Valley. There are certain amounts of entitlement that are not subject to reduction: Joint Water District Board, 5 TAF; Western Canal, 145 TAF; Garden Highway, 5.13 TAF; Plumas Mutual, 6 TAF; Tudor Mutual, 210 AF; and Oswald, 150 AF. "Drought" criteria are defined in the contracts. For more information refer to Appendix E.

SWP Water Allocation – Monterey Agreement

Source: 1995 Monterey Agreement

South-of-Delta Allocation:

Total south-of-Delta SWP deliveries are determined based upon spring storage conditions at Lake Oroville and SWP San Luis and forecasted runoff available to the SWP. Based upon the annual delivery determined, the annual delivery is allocated as a percentage of contractual entitlement that is equal for all SWP contractors. For more information refer to Appendix E.

CVP Water Allocation

Source: various CVP Settlement, Exchange, Agriculture and Municipal Water Service Contracts

CVP water supply allocation is performed based on Shasta index and a tiered priority method. Water supply allocation to Settlement contractors, Exchange contractors, and refuge are based on Shasta index alone. Deliveries to agricultural service contractors and M&I contractors are determined based on available water supply.

If Shasta index is critical then deliveries to Settlement contractors, Exchange contractors, and refuges are reduced to 75% of contract amount. Allocation to these contractors is not affected by water availability, and they receive full allocation in all non-Shasta critical years.

Water allocation to agricultural service contractors and M&I contractors are accomplished using a tiered allocation. In the first tier, agricultural service contractors are reduced to 75% of contract amount while M&I allocations are not reduced. In the second tier, both M&I and agricultural service contractors are reduced by equal percent of allocation until M&I is reduced to 75% and agricultural service is reduced to 50%. In the third tier, M&I remains at 75 % and agricultural service contractors are reduced to 25% of contract. In the fourth and final tier, M&I and agricultural service contractors are reduced on an equal percentage basis until M&I reaches 50% and agricultural service contractors are reduced to 0%.

CVP/SWP Coordinated Operations - 1986 Coordinated Operations Agreement

Source: 1986 Coordinated Operations Agreement (COA)

Sharing of Responsibility for In-Basin-Use:

Based upon the rules in the Coordinated Operations Agreement, specifically the definition of “Balanced Condition”, the project shares of responsibility for In-Basin-Use are 75% for the CVP, and 25% for the SWP. In-Basin-Use includes project storage withdrawals (including

Trinity River imports into the Sacramento River) for maintaining Delta water quality requirements. The 1986 COA was negotiated in the context of SWRCB D-1485.

Sharing of Surplus Flows:

Based upon the rules in the Coordinated Operations Agreement, the project shares of Surplus Flows are 55% for the CVP, and 45% for the SWP. A project's share of Surplus flows includes project storage increase (after accounting for Trinity River imports into the Sacramento River) and Delta exports. The 1986 COA was negotiated in the context of SWRCB D-1485.

D-1485 requires export reductions for Striped Bass, and through agreements CVP provides support for these export reductions. In turn SWP wheels, at priority, at a later time, replacement water for the CVP. This replacement pumping is accounted for as a CVP export. No other Wheeling is accounted for under COA.

CALSIM II uses a simplified accounting of the COA. CALSIM II operates to COA sharing formulas to the extent possible within each time-step. Any outstanding imbalance in this sharing is ignored. In actuality, CVP and SWP operators will similarly allow an imbalance to necessarily occur during periods of the year, but will track and frequently attempt to reconcile these imbalances throughout the year. Due to the need to account more closely for CVP and SWP actions that require and are based on project specific accounting techniques, it is anticiapted that "annual" COA accounting is required.

CVP/SWP Coordinated Operations – SWRCB D-1641

Source: unsupported

Sharing of Restricted Export Capacity:

The 1986 COA makes no specification regarding the project obligations for reducing export under D-1641 export restrictions. Under informal operating arrangements, USBR and DWR have shared the remaining allowable export capacity. A 50%-50% split of export capacity sharing is assumed.

CVP/SWP Coordinated Operations – USFWS discretionary use of CVPIA 3406(b)(2)

Source: 1992 CVPIA

Sharing of Restricted Export Capacity:

The obligation for 3406(b)(2) related reductions in Delta export is the sole responsibility of the CVP. In order to implement 3406(b)(2) reductions in Delta export, cooperation is required from SWP operations (i.e if CVP exports are reduced and CVP water abandoned in the Delta, the SWP export could increase to capture the abandoned supply unless SWP cooperates in the export reduction action). Any such SWP cooperation must be provided for through other mechanisms besides 3406(b)(2), the most logically being the CALFED Environmental Water Account. Please refer to Appendix G for more information.

CVP/SWP Coordinated Operations – CALFED Fisheries Agencies discretionary use of EWA

Source: 2000 CALFED ROD, Environmental Water Account

Sharing of Restricted Export Capacity:

The obligation for EWA related reductions in Delta export is the EWA's. The projects are assumed to cooperate as needed to facilitate EWA actions in so far that the EWA operations adhere to the agreed upon EWA operations guidelines attached to the CALFED ROD. These guidelines require the EWA to use its assets to maintain the project's capability for current and future year deliveries, as defined under the CALFED ROD. Please refer to Appendix H for more information.

CVPIA 3406(b)(2)

Source: 1992 CVPIA

Allocation:

CVPIA 3406(b)(2) requires that 800 TAF of CVP yield, annually, be allocated to fisheries purposes. This allocation is reduced to 600 TAF in years that fall within the Shasta Index Critical year criteria.

Actions:

A procedure for implementing CVPIA Section 3406(b)(2) based actions and accounting is incorporated into CALSIM II. This procedure is documented in Appendix G. The procedure maintains a 3406(b)(2) water account and allocates the account based on forecast information and action specific priorities. These actions are shown in Table 45. Specifics about assumptions for individual actions are included in the Regulatory Standards section.

In the dynamic accounting, each month the remaining allocation of 3406(b)(2) is assessed. Actions are taken each month if the remaining allocation exceeds the amount of reserve required for equal or higher priority later actions shown in Table 45. 3406(b)(2) support for the WQCP is capped at 450 TAF/Yr. Later actions may end up actually costing more or less than the reserve amount shown. The reserve amounts are adjusted to obtain the desired action implementation through the simulation period.

Table 45: CVPIA 3406(b)(2) Actions Schedule

Action Description	Reserve for Later Actions (TAF)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
WQCP Support (D-1641)													
AFRP Releases													
Export Reductions (150 taf)	145 - 285												
VAMP Export Restrictions													
Post VAMP Export Restrictions	102												
Export Ramping	60 - 130												
Pre VAMP Export Restrictions	98												
Export Reduction (35 taf)	155												
Additional Upstream Releases													

CVP

CALFED Environmental Water Account

Source: 2000 CALFED ROD, Environmental Water Account

Actions:

A procedure for implementing EWA based actions and asset expenditure is incorporated into CALSIM II. This procedure is documented in Appendix H. The procedure maintains a water account and allocates the account based on forecast information and action specific priorities. These actions are shown in Table 46. Specifics about assumptions for individual actions are included in the Regulatory Standards section. The account is maintained through exercise of EWA assets, which are discussed in the following section.

In the dynamic accounting, each month the remaining available EWA assets are assessed. Actions are taken each month if the amount of remaining available assets exceeds the amount of reserve required for equal or higher priority later actions shown in Table 46. Later actions may end up actually costing more or less than the reserve amount shown. The reserve amounts are adjusted to obtain the desired action implementation through the simulation period.

Table 46: EWA Actions Schedule

Action Description	Reserve for Later Actions (TAF)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
AFRP Releases (Nov. 20th, 1997)													
Export Reductions – 4000 cfs for 1 week/month (2 weeks/month in Wet years)	25 – 280												
VAMP Export Restrictions	0 – 100												
Pre VAMP Export Restrictions	140												
Post VAMP Export Restrictions	0 – 300												

Export Ramping	0 – 125														

CVP CVP/SWP

Assets:

Two types of assets support the EWA: “operational” and “fixed” assets. The assets and their associated potential benefit to the EWA is shown in Table 47. The operational assets values will not be known until they are applied. The fixed assets, particularly the south-of-Delta purchases, can be used to temporarily cover the risk of the uncertainty of the benefit of the operational assets.

Table 47: EWA Assets

Asset Description	Estimates of average asset potential	
	Operational	Fixed
50% of use of JPOD (Excess SWP Capacity)	75 TAF/Yr	
50% of any CVPIA 3406(b)(2) or ERP releases pumped by SWP	40 TAF / Yr	
Flexing of Delta Export/Inflow Ratio (not explicitly modeled)	30 TAF/Yr	
Dedicated 500 CFS increase of Jul – Sep Banks PP capacity	50 TAF/Yr	
North-of-Delta purchases		35 TAF/Yr
South-of-Delta purchases		50 – 200 TAF/Yr
South-of-Delta source shifting agreements	100 TAF/Yr	
200 TAF/YR South-of-Delta groundwater storage capacity	Ongoing use	One time 200 TAF

Debt Restrictions:

No planned carryover of debt is allowed past the end-of-September. Debts are not reset. Therefore, actions must be limited to the amount of assets that are maintained and accrued with minimal uncertainty. If an unplanned debt is carried past September, it must be repaid at priority before the end-of-February. The debt may be reset by spill during this period.

APPENDICES

The appendices provide additional information about CALSIM II in the following major areas. Currently the appendices are incomplete, rough drafts. They will continue to be updated as new documentation becomes available.

A. CALSIM II, General Modeling Approach
B. DWR / USBR Joint Hydrology
C. Subsystem operations / Integrated operations
D. ANN based Delta Flow-Salinity Relationships / logic
E. CVP / SWP Delivery Allocation and Other operations rules
F. COA accounting (including Export Restriction sharing)
G. B2 operations / accounting
H. EWA operations / accounting